Accessing the sea quark polarization via *W* measurements at PHENIX

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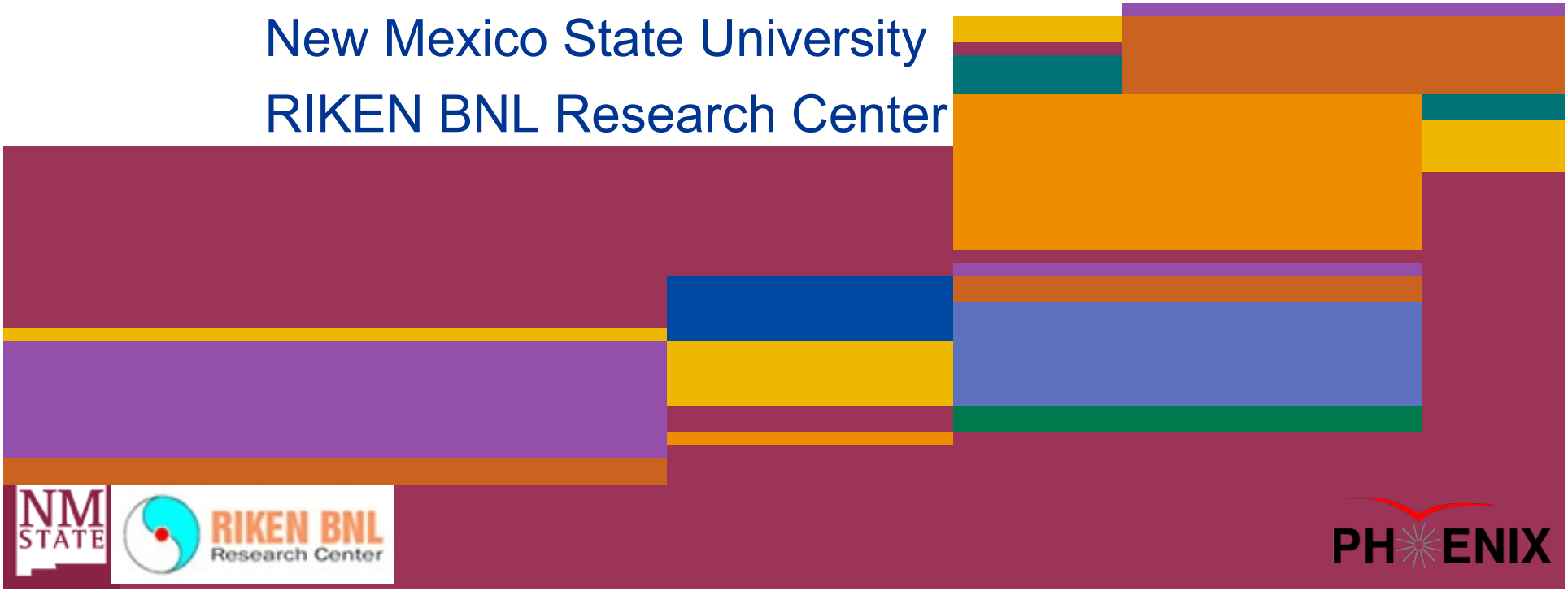


Proton Spin 1/2: Crisis behind one half

The challenge of "Too Small"

Know very little

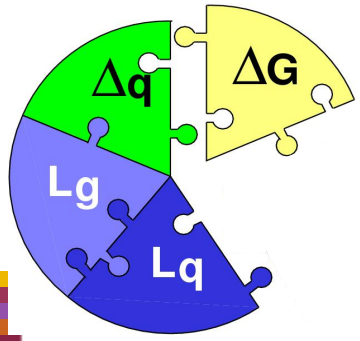
$$\frac{1}{2} = \frac{1}{2}\Delta\Sigma + \Delta G + \Delta L_q + \Delta L_g$$

~0.33 (small)

Poorly constrained

$$\Delta\Sigma = \Delta u + \Delta d + \Delta\bar{u} + \Delta\bar{d} + \ldots$$

Poorly constrained



RHIC Spin Program

- Longitudinal spin program

-- Gluon polarization distribution

$$\Delta G = \int_0^1 dx \cdot \Delta g(x)$$

-- Anti-quark sea polarization

$$A_L(u + \bar{d} \rightarrow W^+ \rightarrow l^+ + \nu_l)$$

$$A_L(\bar{u} + d \rightarrow W^- \rightarrow l^- + \bar{\nu}_l)$$

- Transverse spin program

sensitivity to <Lz> + transversity

Polarized Parton Distribution Function

- 20 years of DIS/SIDIS measurements

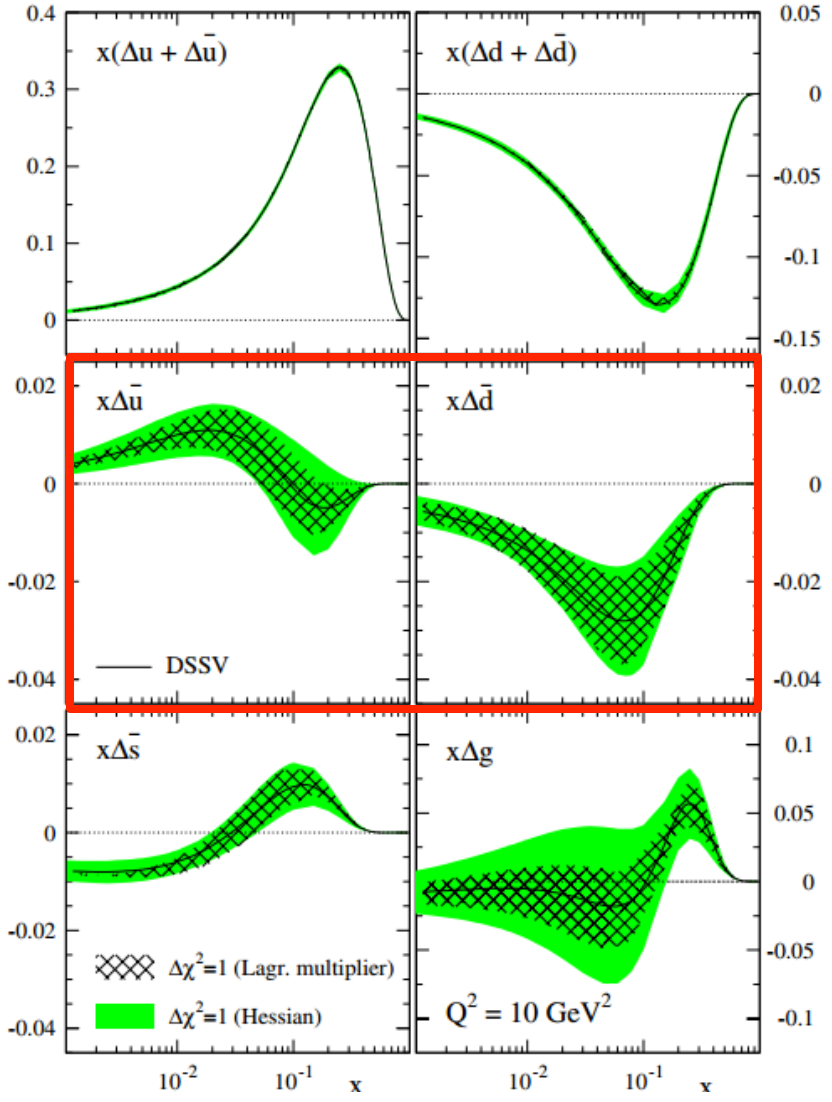
Sensitive to quark antiquark sum

- Recent pp collisions at RHIC

Constrain on gluon polarization

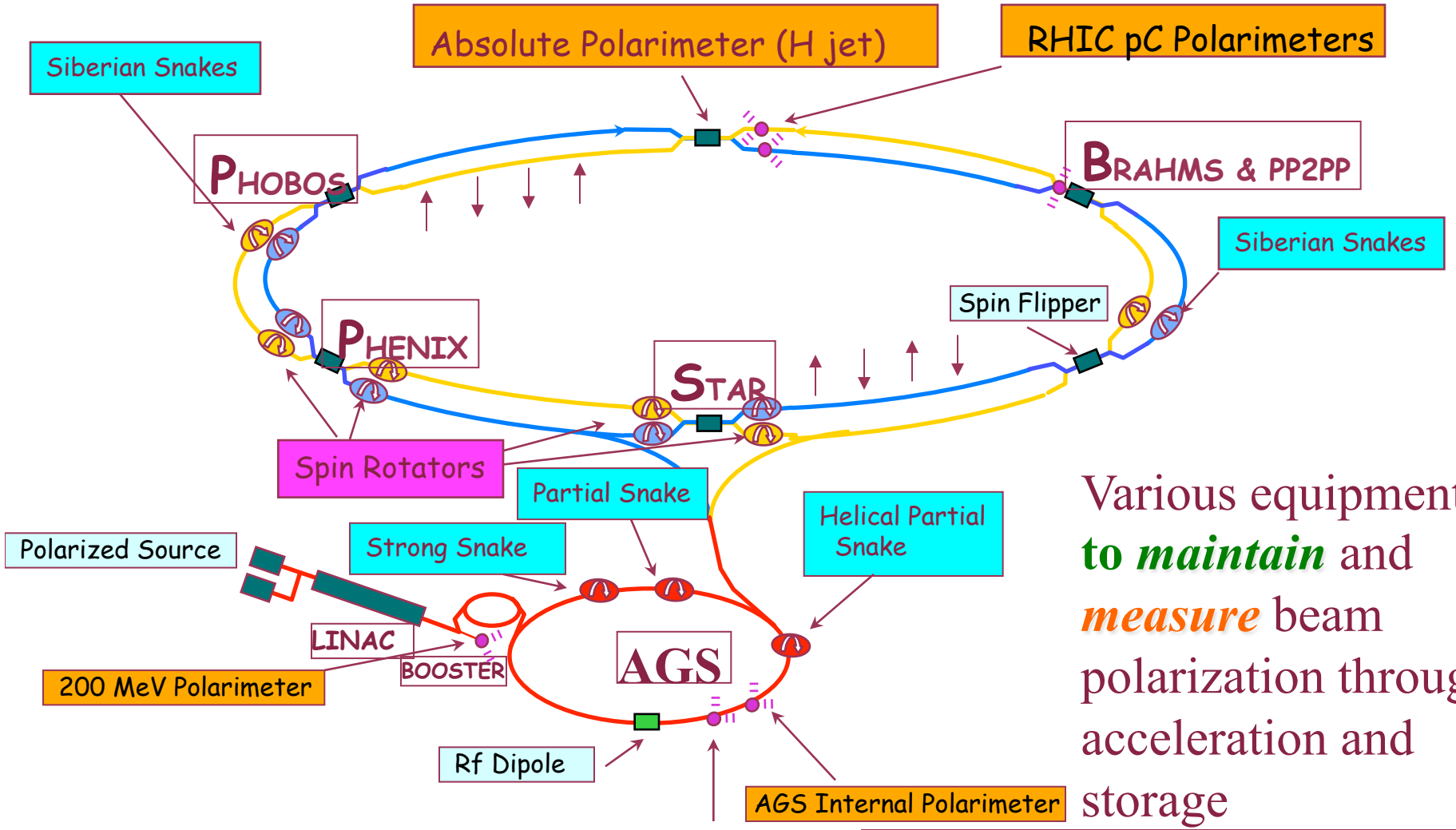
- Our measurement allow us to access sea quark contribution

$\Delta\bar{u}$ and $\Delta\bar{d}$



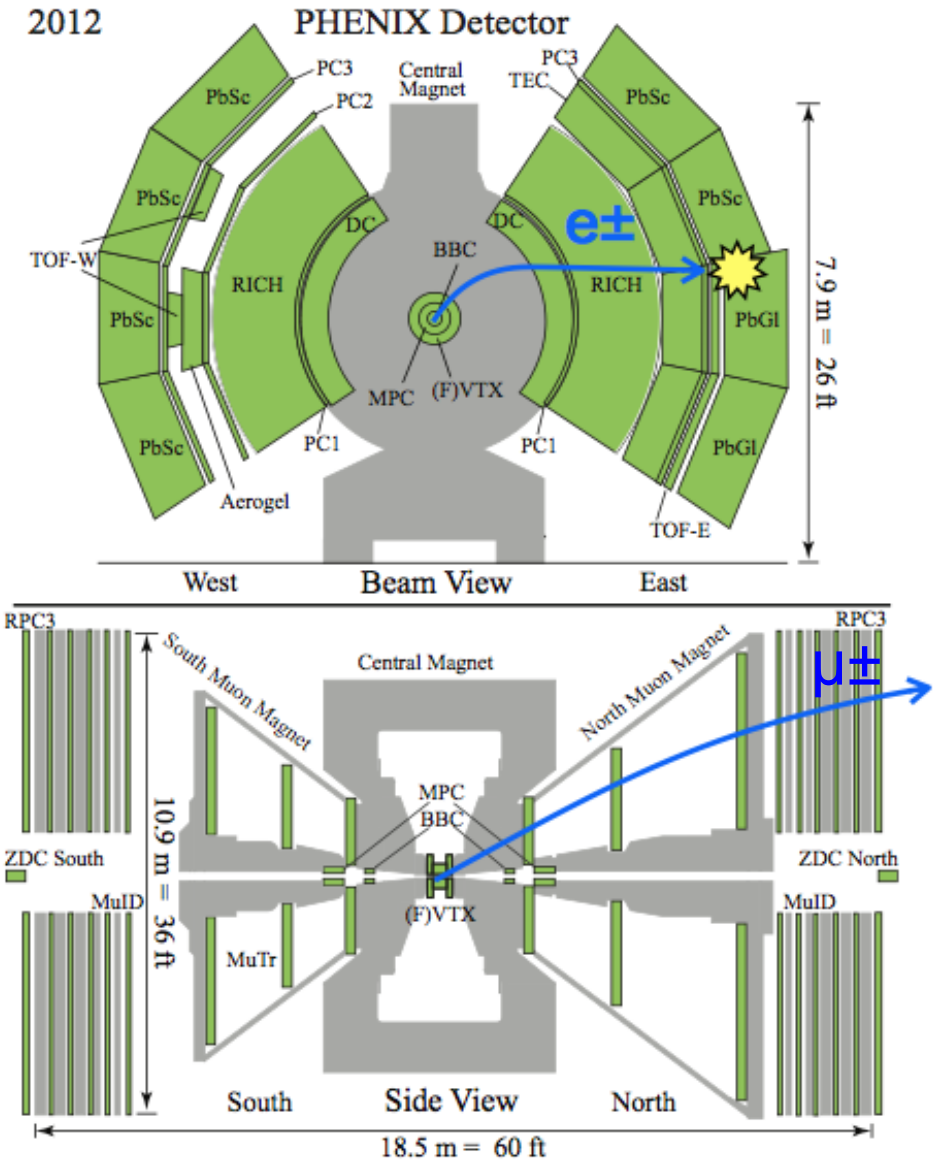
Phys. Rev. D 80, 034030 (2009)

RHIC as a Polarized p + p Collider



Various equipment **to *maintain*** and ***measure*** beam polarization through acceleration and storage

Measurement of W at PHENIX



Central Arms

$|\eta| < 0.35$

Trigger: EMCal + RICH ("ERT")

Detectors: DC, PC, EMCal

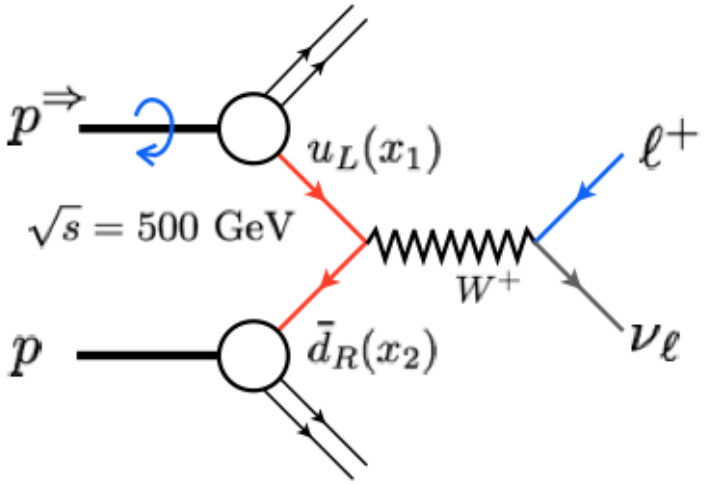
Muon Arms

$1.2 < |\eta| < 2.4$

Trigger: Small sagitta + MuID + timing (RPC/BBC)
Detectors: MuTr, MuID, RPC, BBC FVTX

Flavor-Separated Sea Quark at PHENIX

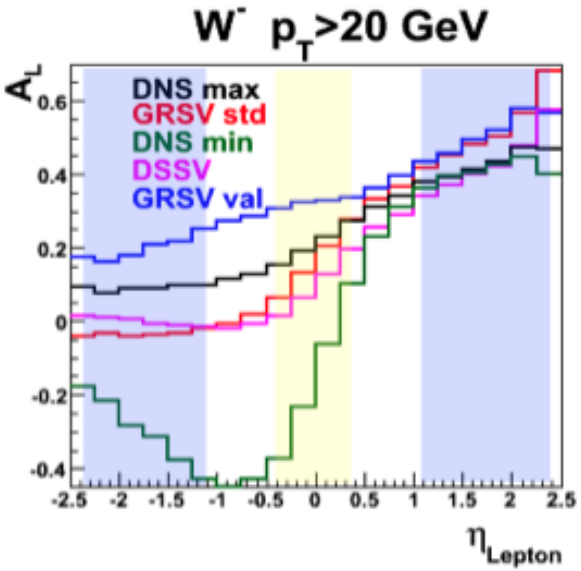
W production

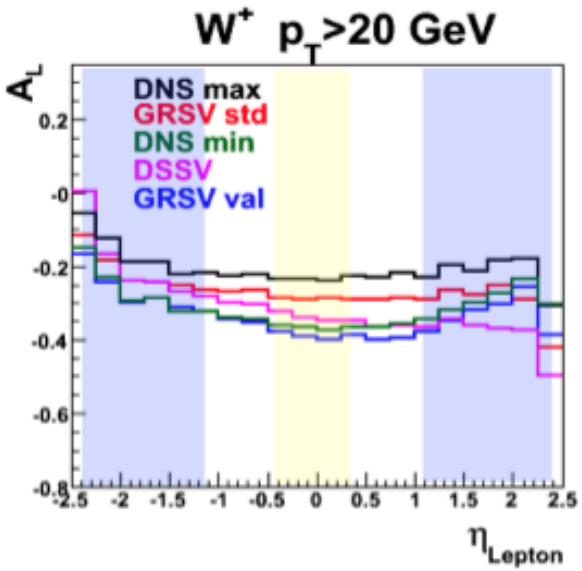


$$u + \bar{d} \rightarrow W^+ ; \bar{u} + d \rightarrow W^-$$

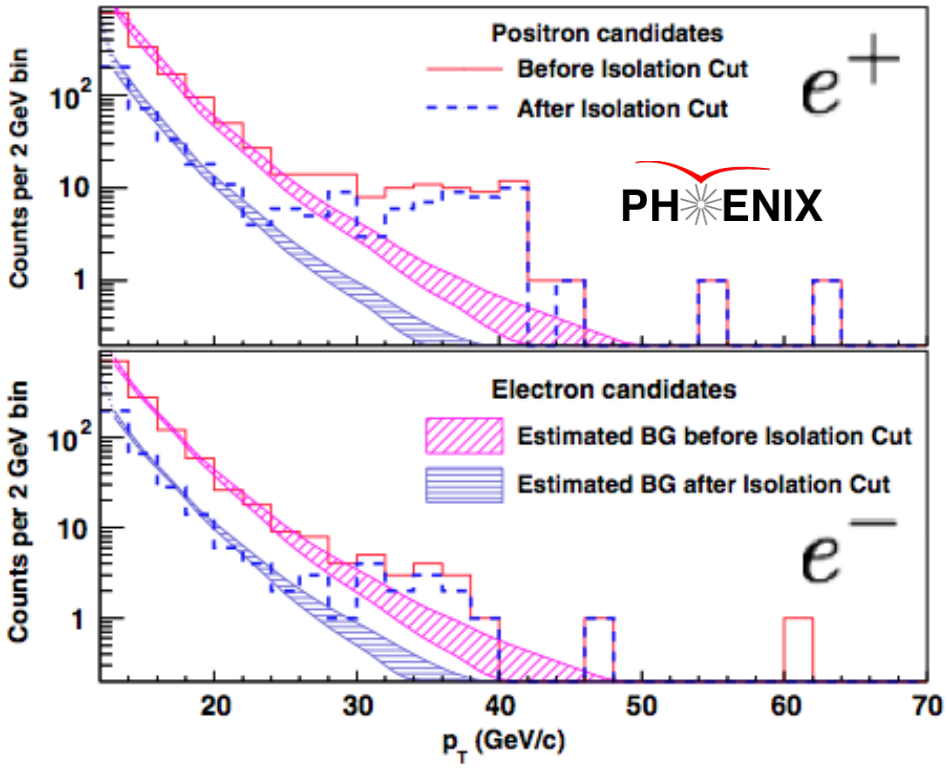
W asymmetry A_L

$$A_L = \frac{\sigma_- - \sigma_+}{\sigma_- + \sigma_+}$$

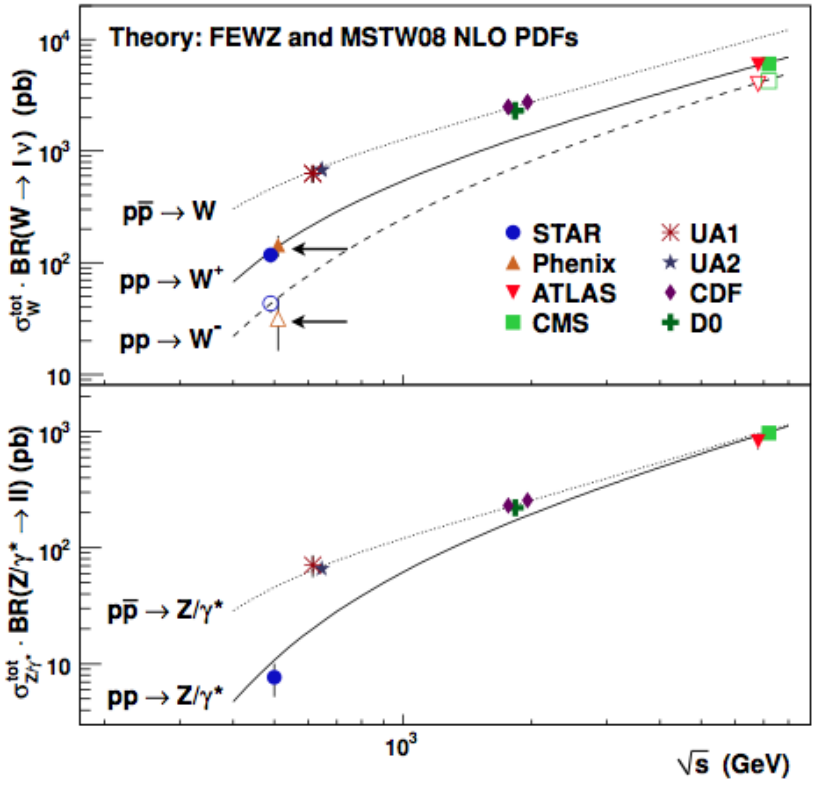




$W^{\pm} \rightarrow e^{\pm}$ Cross Section in Central Arm



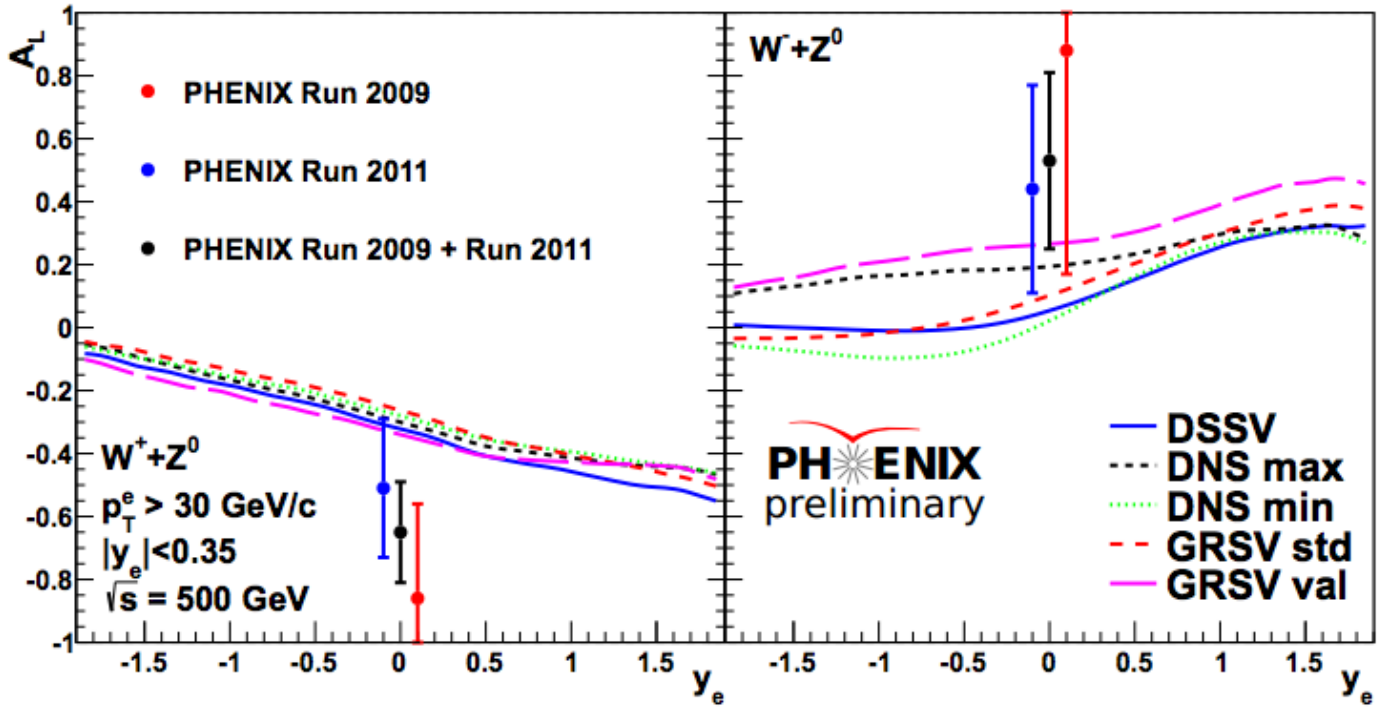
Phys. Rev. Lett. 106 (2011) 062001



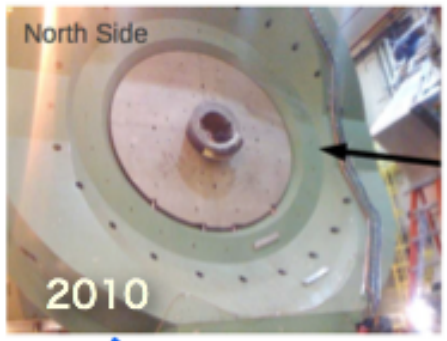
Phys. Rev. D85 (2012) 092010

W cross sections for e decay cannel from both PHENIX and STAR described well along with Tevatron and LHC data.

$W^{\pm} \rightarrow e^{\pm}$ A_L at Central Arm

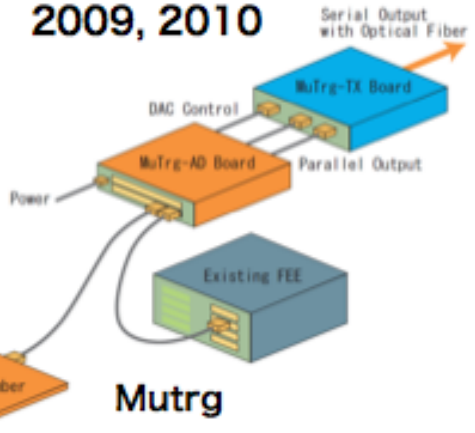


PHENIX Forward Upgrade Program

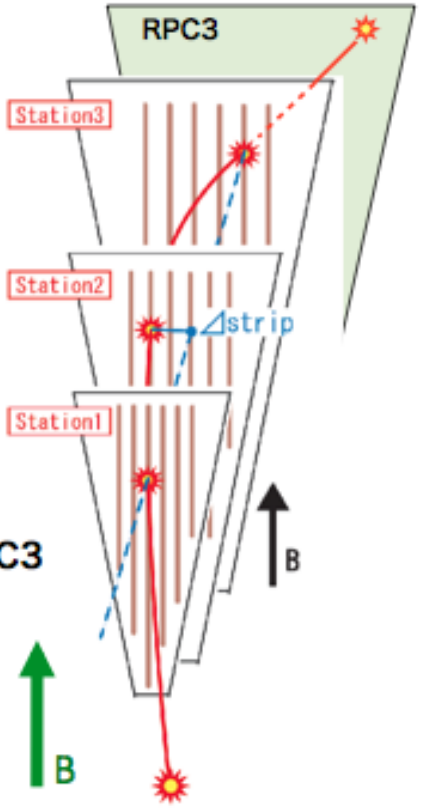


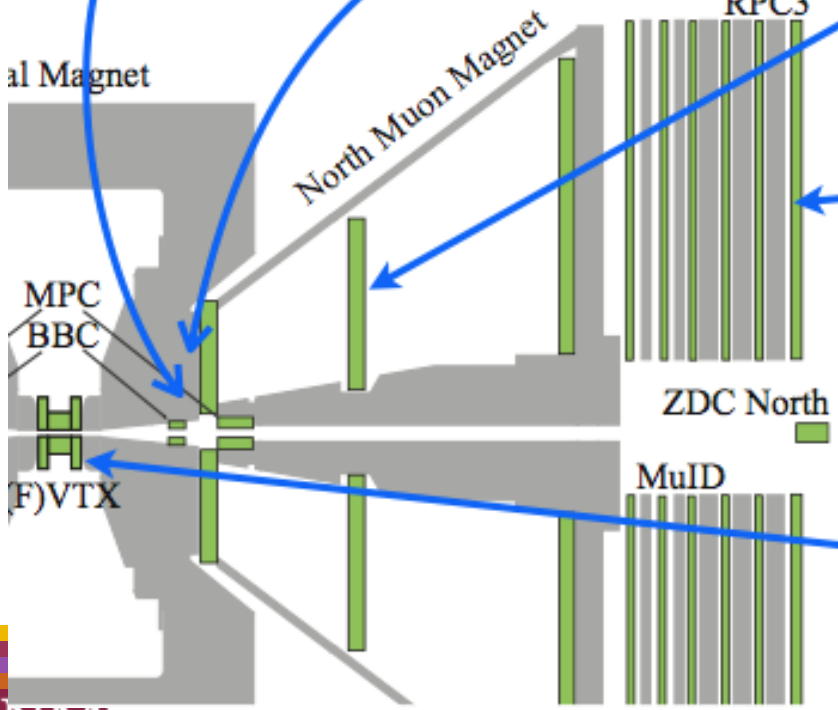
Absorber

RPC1

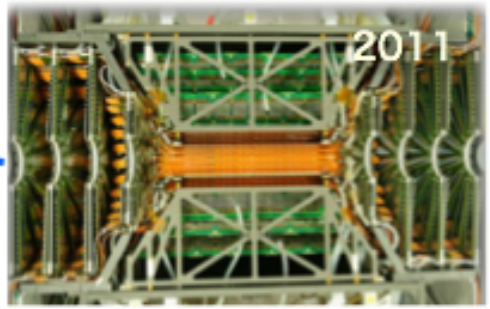


Mutrg





RPC3



FVTX

Single Muon Spectrum at Forward Rapidity

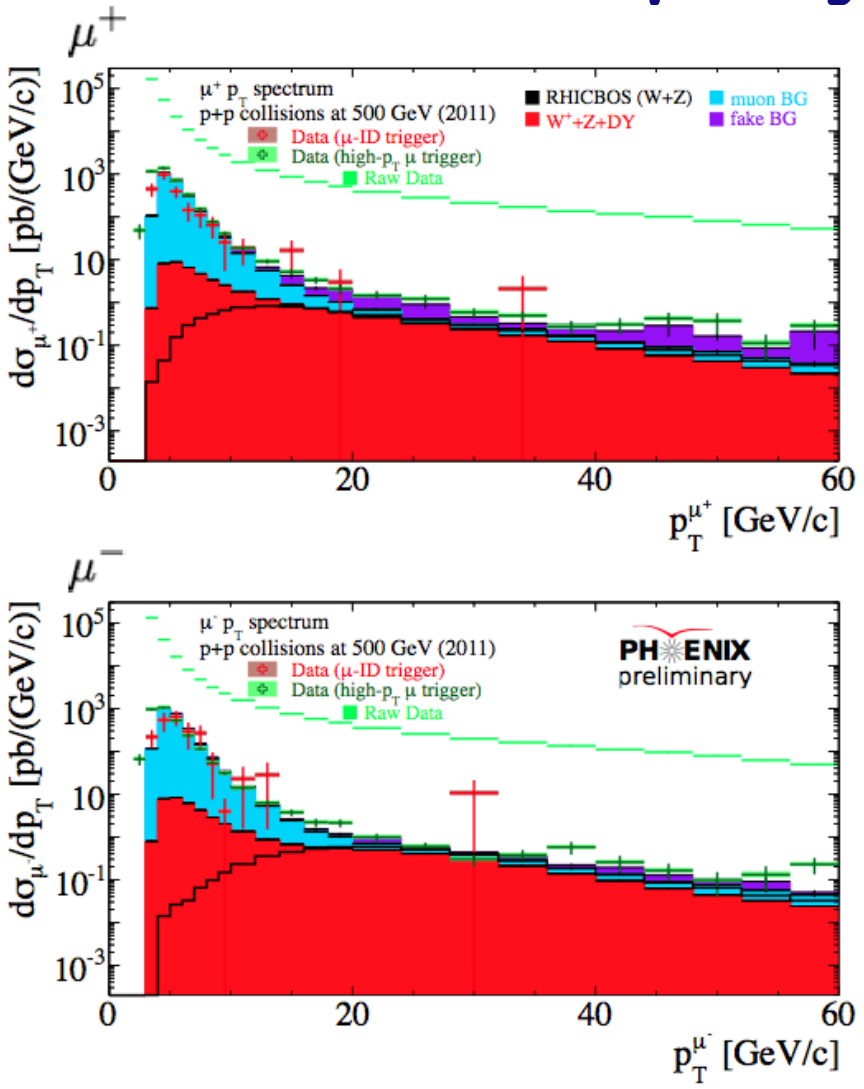
Data and simulated muon cross section

W→μ signal

Irreducible background

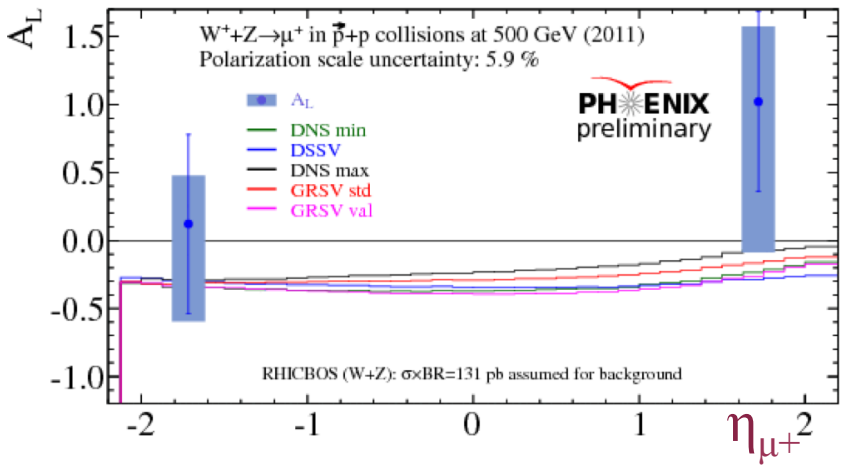
Fake background

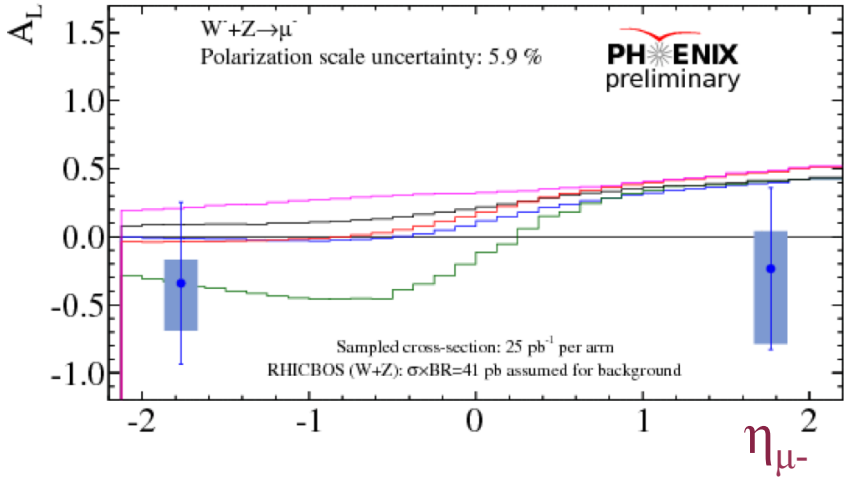
Signal to background ~1:3 (p_T > 15 GeV/*c*)



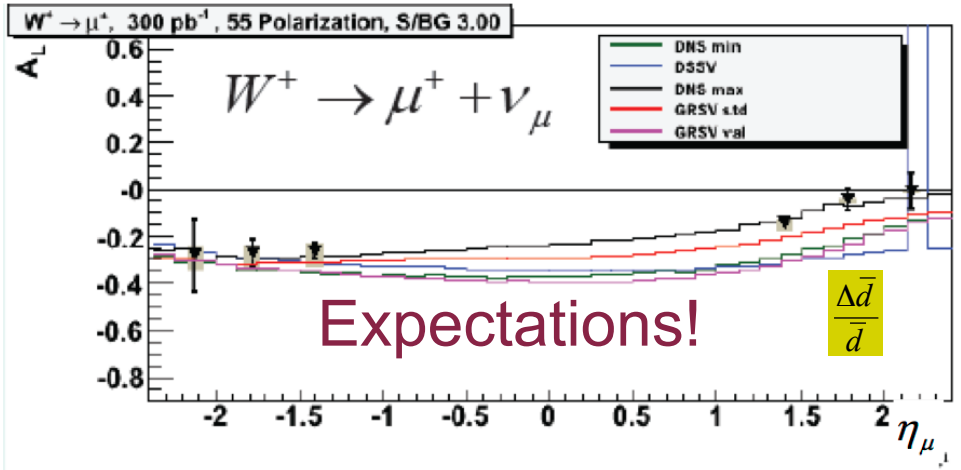
First $W^{\pm}\rightarrow\mu^{\pm}$ A_L at Forward Rapidity

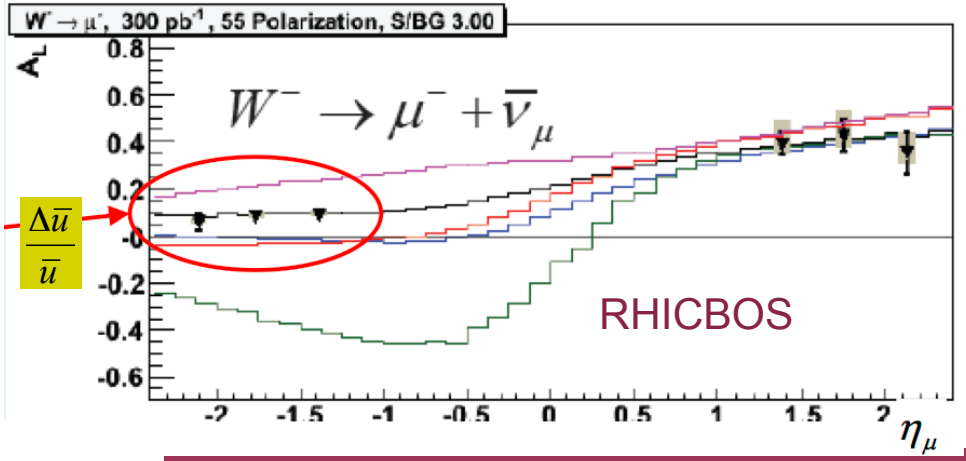
Run2011 L = 25.5 pb^{-1}/arm, P =50%





L = 300 pb^{-1}, P =55%, S/B =3.0

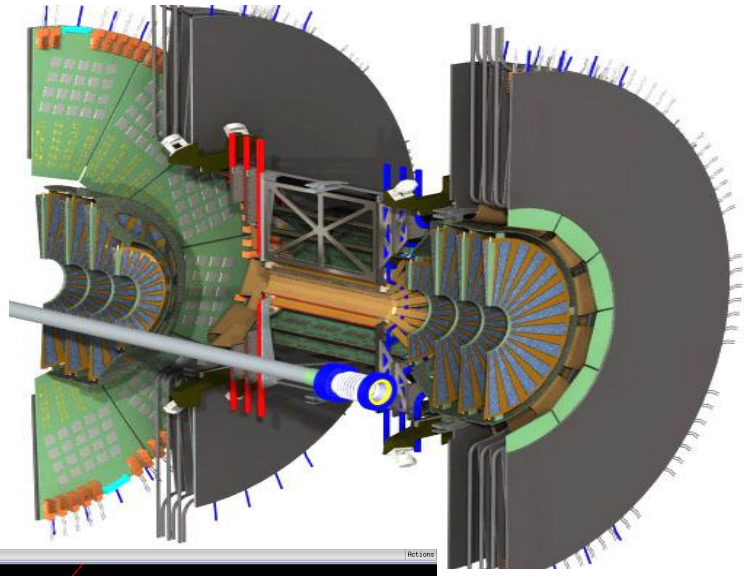




Expect FVTX to make contribution on background reduction!

FVTX Commissioning and Current Status

FVTX covers $1.2 < |\eta| < 2.4$, 2π in φ;
1.1 Million strips (each 75 μm radial, 3.75 in φ);

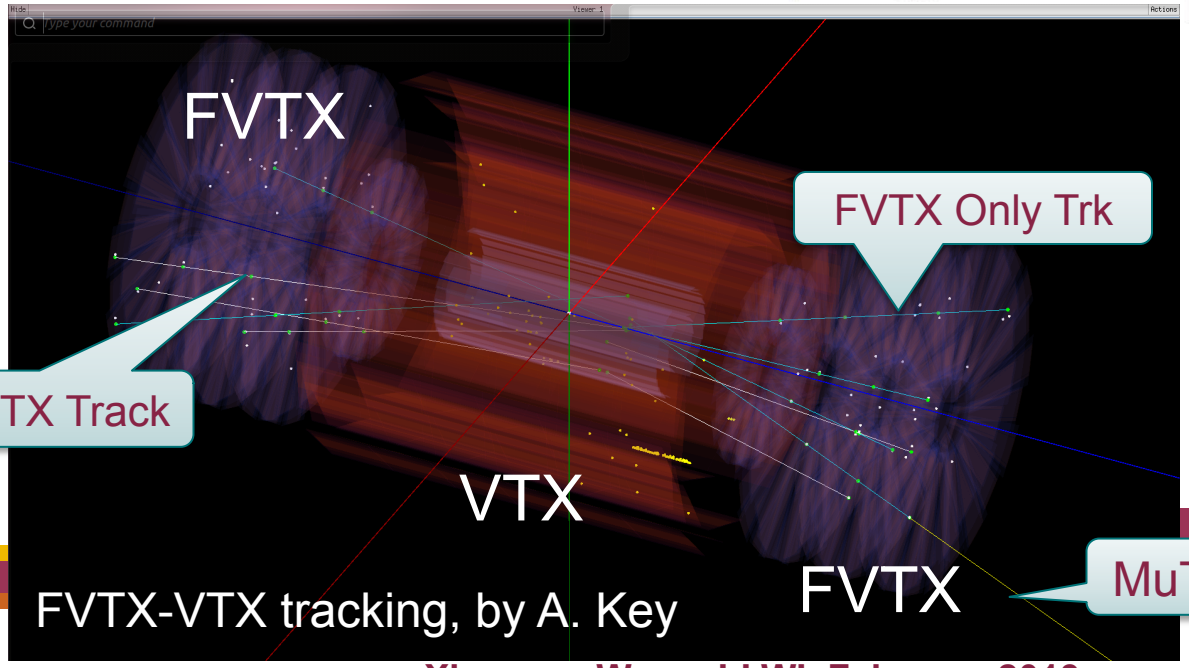


Expected to improve analysis power by

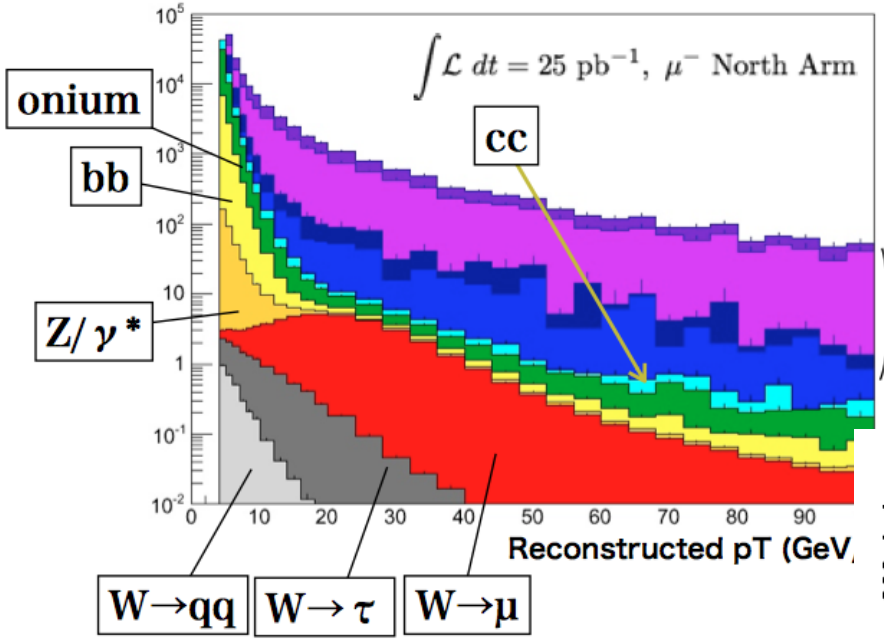
- Precise vertex determination
- Better Tracking

Summary of FVTX Status in 2012

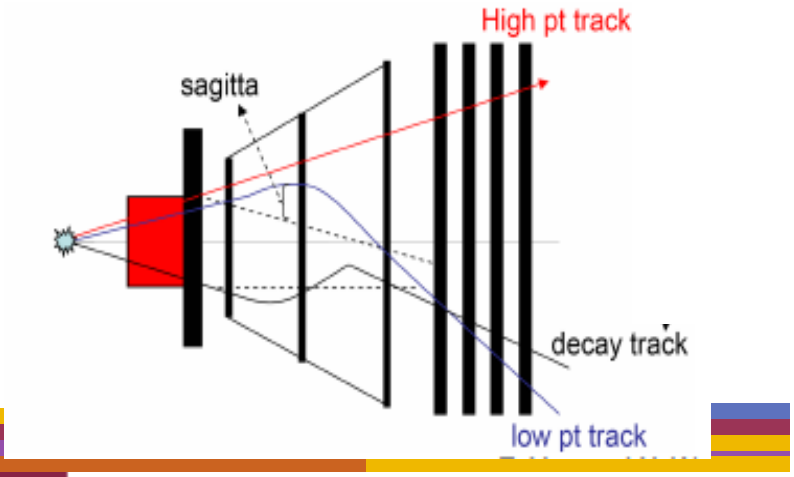
- Over 90% of Detector is operational
- FVTX collected 30pb^{-1} data in pp 500GeV



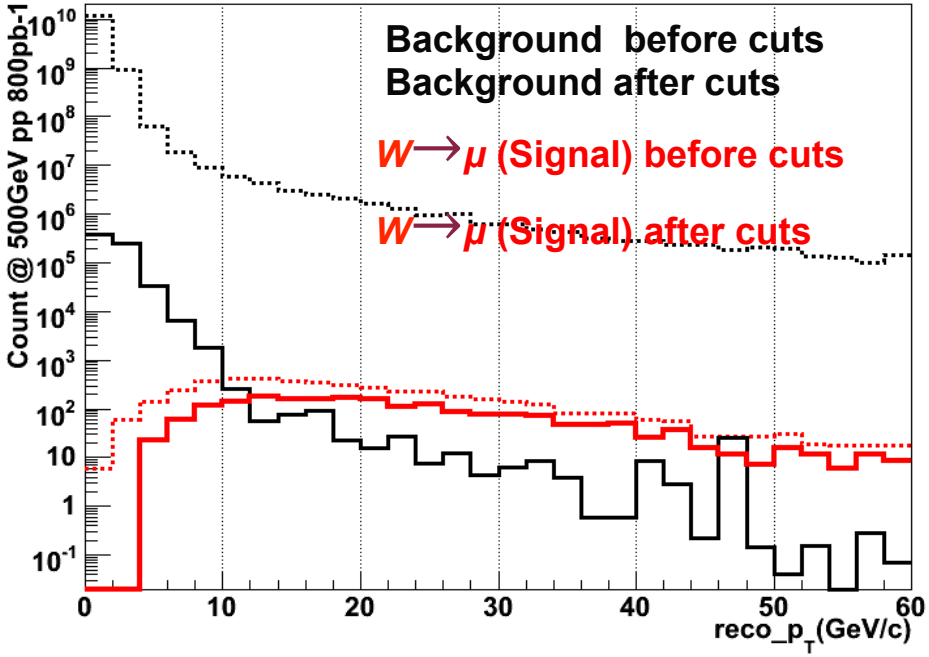
$W^{\pm} \rightarrow \mu^{\pm}$ Background Study



- Dominated background is from misreconstructed low p_T hadrons



Background reduction with FVTX (simulation)



Summary and Outlook

- *W* asymmetry offers a cleaner and more direct probe of sea quark spin.
- PHENIX has measured *W*s at mid and forward rapidities through *W*->*e*(*μ*) decay.
- Run12 p+p 510 GeV run ended successfully. Taking data with VTX, FVTX, and RPC. Analysis is under the way.
- In Run13, an integrated luminosity of 250 pb^{-1} within 30cm vertex range is anticipated with full upgraded hardware set ready.